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Technical Note

Oceanographic Determinants of the Abundance of Common Dolphins (*Delphinus delphis*) in the South of Portugal

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Received: 5 July 2020; Accepted: 25 August 2020; Published: 28 August 2020

Abstract: Off mainland Portugal, the common dolphin (*Delphinus delphis*) is the most sighted cetacean, although information on this species is limited. The Atlantic coast of Southern Portugal is characterized by an intense wind-driven upwelling, creating ideal conditions for common dolphins. Using data collected aboard whale-watching boats (1929 sightings and 4548 h effort during 2010–2014), this study aims to understand the relationships between abundance rates (AR) of dolphins of different age classes (adults, juveniles, calves and newborns) and oceanographic [chlorophyll a (*Chl-a*) and sea surface temperature (SST)] variables. Over 70% of the groups contained immature animals. The AR of adults was negatively related with *Chl-a*, but not related to SST values. The AR of juveniles was positively related with SST. For calves and newborns, although the relationship between SST and AR is similar to that observed for juveniles, the effect could not be distinguished from zero. There was no relationship between *Chl-a* levels and the AR of juveniles, calves and newborns. These results corroborate previous findings that common dolphins tend to occur in highly productive areas demonstrating linkages between their abundance and oceanographic variables, and that this region may be a potential nursery ground.

Keywords: ecology; oceanography; Portugal; abundance rate; nursery; common dolphin; *Delphinus delphis*

1. Introduction

The abundance and distribution of cetaceans is influenced by a series of oceanic and environmental variables [1,2]. Several studies worldwide have demonstrated these relationships, and have shown that cetacean movements vary within and between species [2] and are influenced by numerous variables, including sea-surface temperature [3,4], salinity [3], depth [5], seabed gradient [6], thermocline [7], oxygen minimum layer [8] and prey availability [9]. As top predators, cetacean distribution is closely related to the distribution of their prey [10–12], which in turn can be affected by upwelling systems [13–15] and SST [1]. Thus, in order to understand the factors driving cetacean distribution, insight into these environmental variables is needed.

The Iberian Peninsula constitutes an excellent scenario for conducting ecological niche studies of small cetaceans, because it constitutes a transition area between two distinct environments (i.e., the Mediterranean Sea and the North Atlantic Ocean), and thus exhibits a high level of habitat complexity [16,17]. The coastal region off southwest Iberia is part of the North Atlantic eastern boundary, which encompasses the northern branch of the Canary/Iberian Eastern Boundary Upwelling System (EBUS)—one of the world's foremost productive marine ecosystems [18] and the western part of the northern margin of the Gulf of Cadiz [19,20] (Cape St. Vicente point—Sagres, see Figure 1). This region is characterized by an intense wind-driven upwelling season spanning from March to October, and by an upwelling center in the area of Cape St. Vicente [21]. These features restrict sardines (*Sardina pilchardus*), one of the main prey species of small cetaceans (e.g., common dolphins) off Portugal [22,23], to coastal waters.

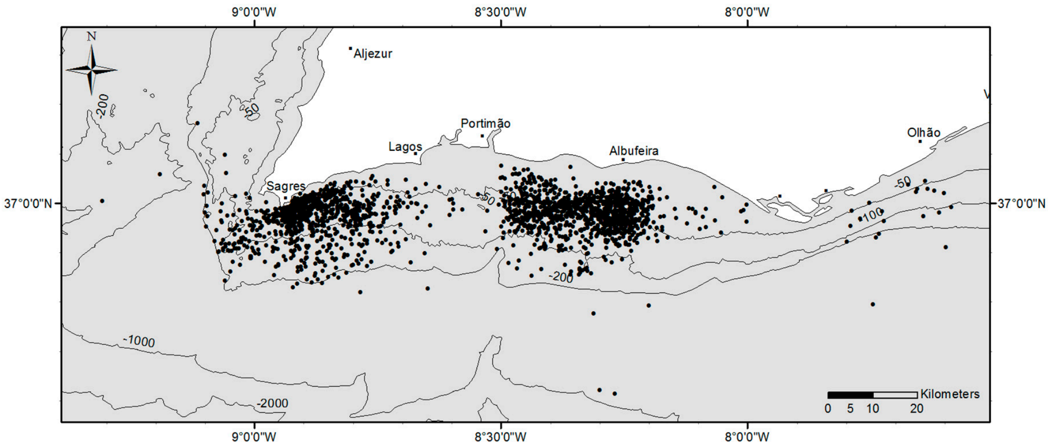

Figure 1. Map of the study area in southern Portugal with bathymetric lines in meters. Each black dot represents one common dolphin (*Delphinus delphis*) sighting.

The south coast of the Iberian Peninsula has been the target of many studies that have revealed a rich cetacean biodiversity [24–26]. However, knowledge concerning the distribution and abundance of cetaceans off the Atlantic coast of the Iberian Peninsula remains scarce and often limited to specific areas [17,24,25,27]. In particular, few studies have examined cetacean occurrence in the waters off southern Portugal [17]. The common dolphin (*Delphinus delphis*) is the most abundant cetacean species in this area [17], although very little is known regarding their biology and ecology, including their abundance and distribution. Further, there is limited information regarding the effect of the aforementioned environmental variables on common dolphin distribution [17]. Common dolphins occur in most coasts of the world, and mainly in the continental shelf but can be found in all depth ranges [28–31]. The common dolphin is described as a highly gregarious species, forming groups of up to several hundreds or even thousands of individuals, although presenting a basic social unit of between 20 to 30 individuals per group [32]. Generally regarded as an opportunistic feeder [10,33], this species is considered a preferential ichtyophageous in the South of Portugal [34], in the Bay of Biscay [35,36] and in the Mediterranean [37].

The apparent lack of studies on cetaceans off southern Portugal could be related to the logistical constraints of performing dedicated cetacean surveys. Such surveys are demanding in terms of the financial resources, time, and personnel required, and thus researchers often utilize alternative study approaches, such as the use of platforms of opportunity (e.g., whale-watching vessels [31,38]). Although there are inherent limitations to this approach (e.g., the potential interaction between the vessel and cetaceans, and the influence of sea state and wind direction on the sighting ability, distribution and behaviour of the animals [38]), platforms of opportunity can yield valuable information regarding cetacean ecology that would otherwise be unobtainable.

To better understand the role of environmental variables on the ecology of common dolphins off southern Portugal, systematic data on their distribution together with oceanographic data must be collected [2]. Therefore, the main goal of this study was to model the abundance of common dolphins in the southern waters of Portugal in relation to oceanographic variables, specifically chlorophyll a (*Chl-a*) and SST, using data collected aboard platforms of opportunity. Ultimately, this study contributes to a better understanding of patterns in the occurrence and habitat use of common dolphins off the Portuguese southern coast.

2. Material and Methods

For the purpose of this study, data collection took place over the span of five years (between April 2010 and November 2014) aboard 11 whale-watching boats from a total of seven companies, which have the common dolphin as one of its target species. Observations occurred along the south coast of Portugal, between the areas of Cape St. Vicente and Olhão (Figure 1) where random transects were conducted, at a maximum distance of 25 nautical miles from shore (the boats used were not allowed to go further offshore due to permits and boat class), and occurred between April and November of each year.

All whale-watching trips occurred between 9 a.m. and 5 p.m., lasting for 90 min each. The number of trips per day varied according to the availability of tourists, the sea state, meteorological conditions and when such conditions were deemed by the whale watching companies as being safe to conduct the activity. During whale-watching trips, two trained observers continuously searched for common dolphins in the region 180° ahead of the vessel. For each common dolphin sighting, GPS position, date and time, bathymetry, group size and composition were recorded. The length of the whale-watching boats was between 7 and 10 m, and bathymetry kept between 30 and 250 m. A group was defined as any pod of dolphins observed in apparent association and moving in the same direction, usually engaged in similar activities [39]. Groups were documented if present at a distance of 300 m to 30 m from the boat. Group composition was described according to the number of adults: individuals between 180 and 220 cm in length, apparently fully grown and physically mature; juveniles: immature animals not yet fully grown, but larger than calves; calves: animals $\leq \frac{1}{2}$ the length of an adult, travelling alongside an adult; and newborns: animals with the same size or less than calves, exhibiting foetal folds and travelling alongside an adult [40]. Immature animals were defined as all individuals that did not appear fully grown (ca < 180 cm).

Sampling effort was measured as the number of hours spent searching for dolphins. Abundance rate (AR) was calculated as the monthly rate of the number of individual common dolphins to the hours of sampling (effort). Only sightings observed from 0 to 4 according to the Beaufort Scale were considered. Sightings observed above Beaufort 4 were discarded.

Concerning the oceanographic variables, L3 satellite-derived monthly night time sea surface temperature (SST) and *Chl-a* data were acquired from Moderate-resolution Imaging Spectroradiometer (Aqua-MODIS; http://oceancolor.gsfc.nasa.gov/), with a spatial resolution of approximately 4 km. The monthly average of each variable was calculated for the area covered by the surveys (Lat: 36.5–37.5, Lon: −10, −7 decimal degrees), before being used in the models.

Sighting data were analyzed according to specific age classes (adult, juvenile, calf and newborn). For each age class, generalized additive models (GAMs) with a lognormal distribution were used to estimate relationships between the AR and environmental variables (SST and *Chl-a*). GAMs are semi-parametric extensions of generalized linear models (GLMs) with the ability to deal with non-linear relationships between response and explanatory variables [41]. As non-linear relationships were expected a priori, GAMs were preferred over GLMs. Year was included as a random effect to account for temporal variance that cannot be explained by the environmental variables.

For all variables, a thin plate regression spline was used. Model selection was done automatically by including an additional penalty for each smooth, so that if smoothing parameters for a term tend to infinity, the term will be selected out of the model [42]. Statistical analysis was performed using the ''mgcv'' [41] package in ''R'' (version 3.6.1, R Development Core Team).

3. Results

Sampling effort totalled 4548 h (Table 1), and a total of 1929 common dolphin groups were sighted. Groups composed only of adults corresponded to 27.52%, while the rest of the sighted groups contained adults and immature animals (72.48%). Calves and/or newborns were present in 42.5% of the sightings.

On average, group size was 31 ± 51.6 individuals (ranging from 1 to 1000 individuals), with groups consisting, on average, of 4.9 ± 8.55% juveniles, 3.0 ± 6.15% calves, and 0.8 ± 3.03% newborns. All age classes were observed in every year sampled, and overall the abundance rates did not differ between years (F = 0.51, p = 0.728; Figure 2).

There was variation in oceanographic variables according to month and year (see Supplementary Figure S1). SST tends to increase during the spring and summer months, reaching higher values towards the end of the summer (months of August and September) depending on the year, while *Chl-a* tends to decrease. For adults, the effect of *Chl-a* was significantly different from zero (which indicates no effect) (p value < 0.05), with a negative relationship between abundance rate and *Chl-a* observed. There was no effect of SST on the abundance rate of adults (Figure 3).

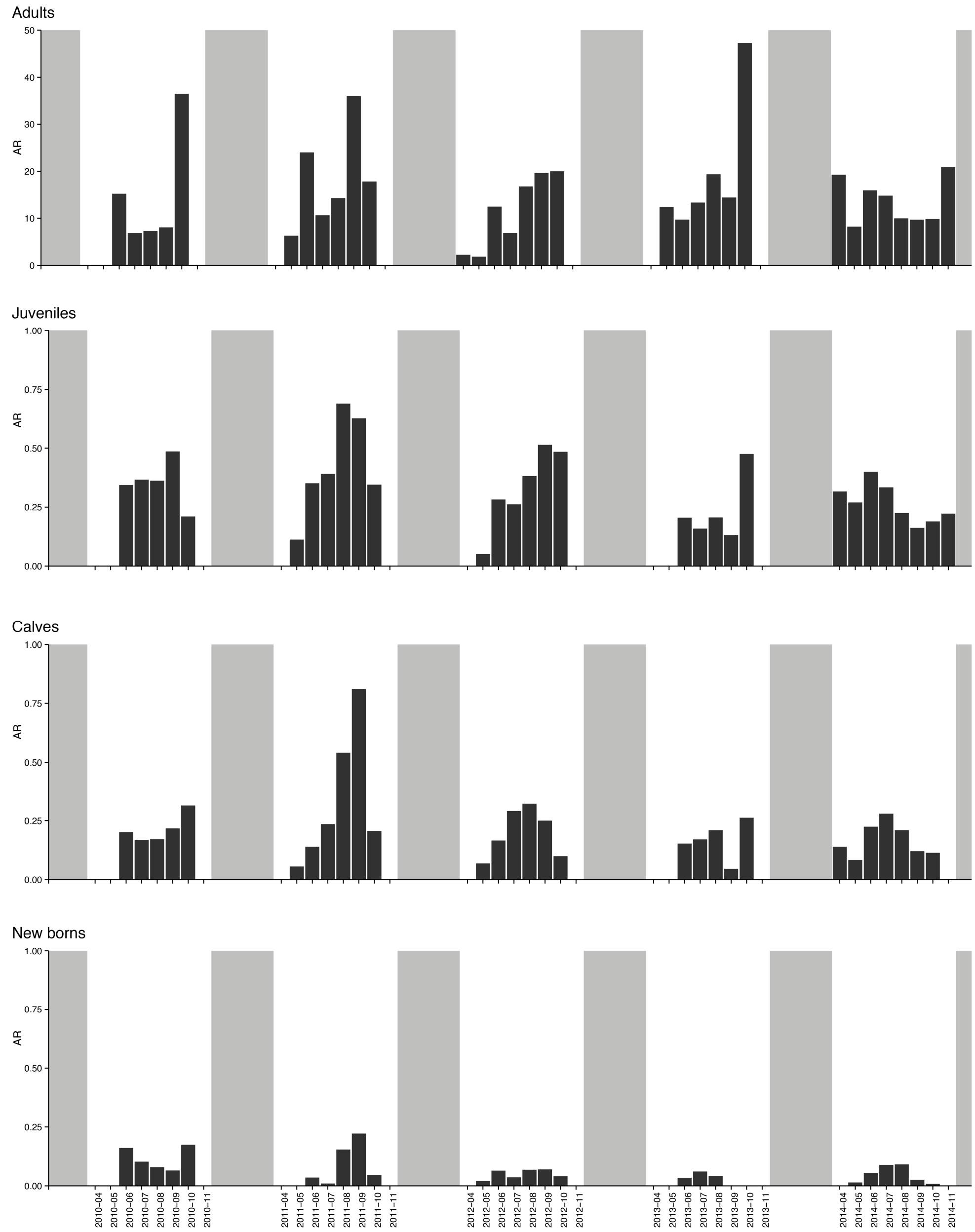

Figure 2. Monthly abundance rates (AR) of common dolphin (*Delphinus delphis*) adults, juveniles, calves and newborns during the study sampling period (April 2010 to November 2014). Grey X-axis breaks represent months with no sampling due to unfavourable winter conditions.

Table 1. Summary of the number of sightings and sampling hours (effort) per month (April to November), during the sampling period of 2010–2014. Grey areas represent months with no sampling due to unfavorable winter conditions.

	April	May	June	July	August	September	October	November	Total
No. sightings 2010	0	0	29	145	164	72	27	0	437
Effort (hours) 2010	0	0	49.5	508.5	658.5	216	28.5	0	1461
No. sightings 2011	13	7	17	64	95	62	31	0	289
Effort (hours) 2011	21	18	28.5	102	174	76.5	43.5	0	463.5
No. sightings 2012	1	8	24	71	119	43	27	0	293
Effort (hours) 2012	13.5	99	78	195	250.5	72	49.5	0	757.5
No. sightings 2013	0	15	43	144	168	67	58	0	495
Effort (hours) 2013	9	19.5	117	280.5	271.5	130.5	42	0	870
No. sightings 2014	17	27	91	120	93	31	34	2	415
Effort (hours) 2014	28.5	70.5	147	192	276	156	121.5	4.5	996

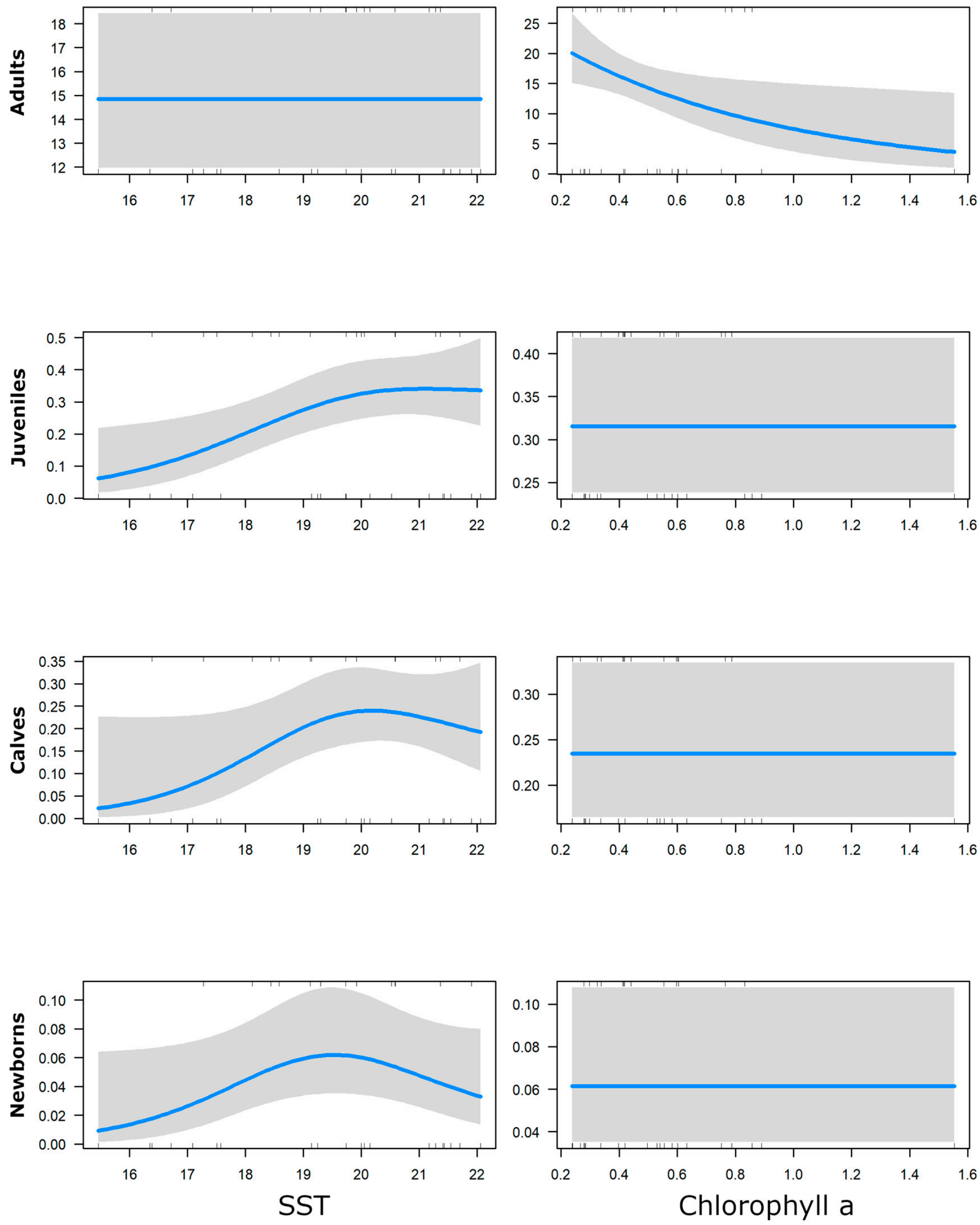

Figure 3. Model predictions for each age class.

For juveniles, the effect of SST was significantly different from no effect (p value < 0.05), with a positive relationship between abundance rate and SST observed. There was no effect of *Chl-a* on the abundance rate of juveniles (Figure 3). Although similar trends between abundance rate of calves and newborns and SST were observed (Figure 3), there was no evidence that the observed trends were different from zero (no effect) with a p-value higher than 0.05 (Figure 3). There was no effect of *Chl-a* on the abundance rate of calves and newborns (Figure 3).

4. Discussion

This study utilized whale watching boats as platforms of opportunity, providing support for its effectiveness as a cetacean research technique. However, it is important to point out some of the limitations that these platforms present when compared with dedicated scientific surveys, namely, in this study, the unsystematic sampling effort that can lead to biased results [17].

Common dolphins are considered to be opportunistic feeders [10,33], thus it is reasonable to expect that their abundance is related to *Chl-a* concentration, which is often used as a proxy for prey abundance and distribution [24]. Previous studies conducted off the Portuguese coast considered that chlorophyll concentration was one of the most important variables associated with this species' distribution [17,43].

In our study, increasing values of *Chl-a* were related to lower AR of adults. It is likely that the reduced ARs could be due to the succession from primary to secondary consumers (i.e., the change in the local trophic web to larger predators, preying upon primary consumers) in response to the increase in microalgae abundance [43]. As such, the presence of potential prey was likely still relatively reduced when *Chl-a* values were higher.

Our results showed a positive relationship between the AR of juveniles and SST values and suggest a similar relationship for calves and newborns. This is consistent with other common dolphin studies, in which groups containing immature individuals (juvenile, calf or newborn) tend to be more frequently associated with warmer waters [44].

The majority of the groups sighted in this study were composed of both adults and immature individuals (this represented 72.48% of the total number of sightings), and the presence of calves and/or newborns (accounting for 42.5%) was of particular relevance. This strongly suggests the importance of this area as a potential nursery ground for common dolphins and is consistent with other studies [31]. Furthermore, several studies indicate that water temperature influences cetaceans births [45–47] and, for example, in bottlenose dolphins (*Tursiops truncatus*) a peak of births usually coincides with a peak in water temperature [45,47]. SST values for the Portuguese coast are highest during the period of intense upwelling activity in southern Portugal (i.e., between March and October [48]). According to Cañadas and Vázquez [49], SST plays a significant role in common dolphin distribution and density and a strong change in SST may affect how this species distributes and their abundance, at least at a local level.

As with previous studies [1,44,50], our results suggest that common dolphin abundance is linked to not only ''extrinsic'' factors (in this case chlorophyll concentration and SST) but also to ''intrinsic'' factors such as the presence of juveniles, calves and newborns. In order to improve our knowledge on common dolphin ecology, it is essential to develop more studies to comprehend how these influences work.

5. Conclusions

Our study has shown that the South of Portugal is an important area for the common dolphin, particularly as a potential nursery ground, and that the AR of this species are associated, to some extent, with oceanographic variables such as SST and chlorophyll. Conservation strategies should consider these relationships, especially with respect to changing conditions due to climate change. For example, changes in upwelling and ocean current oscillation patterns could lead to decreased prey availability, justifying the need for increased conservation and management action. While the common dolphin is currently not considered to be endangered or threatened in Portugal (according to the International

Union for Conservation of Nature [51]), it is important to use a proactive approach and manage this species for "robustness" [52] in order to increase resiliency to future environmental or anthropogenic changes. For effective conservation action, further research is needed to better understand the current human uses of these coastal waters in which common dolphins occur.

Supplementary Materials: The following are available online at http://www.mdpi.com/2673-1924/1/3/12/s1. Figure S1. Monthly variation of the environmental variables examined: Sea Surface Temperature (SST) and Chlorophyll a (Chla). Grey X-axis breaks represent months with no sampling due to unfavourable winter conditions and thus were excluded from analysis. Figure S2. Model validation plots of the four categories: Adults, Juveniles, Calves and Newborns.

Author Contributions: Conceptualization, J.C. and A.C. (André Cid); Methodology, J.C. and A.C. (André Cid); Software, A.C. (Ana Couto), M.I.L. and F.O.B.; Validation, J.C., A.C. (Ana Couto) and F.O.B.; Formal Analysis, A.C. (Ana Couto), M.I.L. and F.O.B.; Investigation, J.C. and A.C. (André Cid); Resources, J.C.; Data Curation, J.C. and A.C. (Ana Couto); Writing—Original Draft Preparation, J.C., F.O.B. and A.C. (Ana Couto); Writing—Review and Editing, H.C.P. and R.R.; Visualization, J.C., A.C. (Ana Couto) and F.O.B.; Supervision, H.C.P. and R.R.; Project Administration, J.C.; Funding Acquisition, J.C., A.C. (André Cid), M.I.L., F.O.B. and R.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Associação para a Investigação do Meio Marinho (AIMM) and Fundação para a Ciência e a Tecnologia (FCT), through Programa Investigador FCT 2013 granted to RR. FCT also supported this study through (i) the strategic project UID/MAR/04292/2019 granted to MARE and (ii) PhD grant to J.C. (SFRH/BD/134156/2017), M.I.L. (SFRH/BD/84297/2012) and F.O.B. (SFRH/BD/147294/2019).

Acknowledgments: The authors would like to thank the following whale-watching companies for their support during this study: Cape Cruiser, AlgarExperience, Dolphins Driven, Dream Wave, X Ride, EcoDolphin and Formosa Mar. A special thanks to all AIMM volunteers who participated in the data collection.

Conflicts of Interest: The authors have no conflict of interest to declare.

References

1. Neumann, D.R. The activity budget of free-ranging common dolphins (*Delphinus delphis*) in the Northwestern Bay of Plenty, New Zealand. *Aquat. Mamm.* **2001**, *27*, 121–136.
2. Hastie, G.; Swift, R.; Slesser, G.; Thompson, P.; Turrel, W. Environmental models for predicting oceanic dolphin habitat in the Northeast Atlantic. *ICES J. Mar. Sci.* **2005**, *62*, 760–770. [CrossRef]
3. Selzer, L.A.; Payne, P.M. The distribution of white-sided (*Lagenorhynchus acutus*) and common dolphins (*Delphinus delphis*) vs. environmental features of the continental shelf of the Northeastern United States. *Mar. Mammal Sci.* **1988**, *4*, 141–153. [CrossRef]
4. Baumgartner, M.F.; Mullin, K.D.; May, L.N.; Leming, T.D. Cetacean habitats in the Northern Gulf of Mexico—Statistical data included. *Fish. Bull.* **2001**, *99*, 219–239. [CrossRef]
5. Gowans, S.; Whitehead, H. Distribution and habitat partitioning by small odontocetes in the gully, a submarine canyon on the scotian shelf. *Can. J. Zool.* **1995**, *73*, 1599–1608. [CrossRef]
6. Baumgartner, M.F. The distribution of Risso's dolphin (*Grampus griseus*) with respect to the Physiography of the Northern Gulf of Mexico. *Mar. Mammal Sci.* **1997**, *13*, 614–638. [CrossRef]
7. Reilly, S.B. Seasonal changes in distribution and habitat differences among dolphins in the Eastern Tropical Pacific. *Mar. Ecol. Prog. Ser.* **1990**, *66*, 1–11. [CrossRef]
8. Polacheck, T. Relative abundance, distribution and inter-specific relationship of cetacean schools in the Eastern Tropical Pacific. *Mar. Mammal Sci.* **1987**, *3*, 54–77. [CrossRef]
9. Cockcroft, V.G.; Peddemors, V.M. seasonal distribution and density of common dolphins *Delphinus delphis* off the south-east coast of Southern Africa. *S. Afr. J. Mar. Sci.* **1990**, *9*, 371–377. [CrossRef]
10. Young, D.D.; Cockcroft, V.G. Diet of common dolphins *Delphinus delphis* off the south-east coast of Southern Africa: Opportunism or specialization? *J. Zool.* **1994**, *234*, 41–53. [CrossRef]
11. Amaral, A.R.; Beheregaray, L.B.; Bilgmann, K.; Freitas, L.; Robertson, K.M.; Sequeira, M.; Stockin, K.A.; Coelho, M.M.; Möller, L.M. Influences of past climatic changes on historical population structure and demography of a cosmopolitan marine predator, the common dolphin (genus *Delphinus*). *Mol. Ecol.* **2012**, *21*, 4854–4871. [CrossRef] [PubMed]

12. Henderson, E.E.; Forney, K.A.; Barlow, J.P.; Hildebrand, J.A.; Douglas, A.B.; Calambokidis, J.; Sydeman, W.J. Effects of fluctuations in sea-surface temperature on the occurrence of small cetaceans off Southern California. *Fish. Bull.* **2014**, *112*, 159–177. [CrossRef]
13. Ballance, L.T.; Pitman, R.L.; Fiedler, P.C. Oceanographic influences on seabirds and cetaceans of the eastern tropical pacific: A review. *Prog. Oceanogr.* **2006**, *69*, 360–390. [CrossRef]
14. Bilgmann, K.; Möller, L.M.; Harcourt, R.G.; Gales, R.; Beheregaray, L.B. Common dolphins subject to fisheries impacts in southern australia are genetically differentiated: Implications for conservation. *Anim. Conserv.* **2008**, *11*, 518–528. [CrossRef]
15. Valdez, F.P.; Corrigan, S.; Möller, L.; Bilgmann, K.; Beheregaray, L.B.; Allen, S. Fine-Scale genetic structure in short-beaked common dolphins (*Delphinus delphis*) along the East Australian current. *Mar. Biol.* **2010**, *158*, 113–126. [CrossRef]
16. Alcaraz, D.; Paruelo, J.; Cabello, J. Identification of current ecosystem functional types in the Iberian Peninsula. *Glob. Ecol. Biogeogr.* **2006**, *15*, 200–212. [CrossRef]
17. Moura, A.E.; Sillero, N.; Rodrigues, A. Common dolphin (*Delphinus delphis*) habitat preferences using data from two platforms of opportunity. *Acta Oecologica* **2012**, *38*, 24–32. [CrossRef]
18. Bograd, S.J.; Rykaczewski, R.R.; García-Reyes, M.; Sydeman, W.J.; Bakun, A.; Miller, A.J.; Black, B.A. Anticipated effects of climate change on coastal upwelling ecosystems. *Curr. Clim. Chang. Rep.* **2015**, *1*, 85–93. [CrossRef]
19. Cravo, A.; Relvas, P.; Cardeira, S.; Rita, F.; Madureira, M.; Sánchez, R. An upwelling filament off southwest iberia: Effect on the chlorophyll a and nutrient export. *Cont. Shelf Res.* **2010**, *30*, 1601–1613. [CrossRef]
20. Cravo, A.; Relvas, P.; Cardeira, S.; Rita, F. Nutrient and chlorophyll a transports during an upwelling event in the NW margin of the gulf of cadiz. *J. Mar. Syst.* **2013**, *128*, 208–221. [CrossRef]
21. García Lafuente, J.; Ruiz, J. The gulf of cádiz pelagic ecosystem: A review. *Prog. Oceanogr.* **2007**, *74*, 228–251. [CrossRef]
22. Silva, M.A.; Sequeira, M. Patterns in the mortality of common dolphins (*Delphinus delphis*) on the portuguese coast, using stranding records, 1975–1998. *Aquat. Mamm.* **2005**, *29*, 88–98. [CrossRef]
23. Beare, D.; Pierce, G.J.; Patterson, I.A.P.; Reid, R.J.; Learmonth, J.A.; Reid, D.G.; Santos, M.B.; Ross, H.M. Variability in the diet of harbor porpoises (*Phocoena phocoena*) in scottish waters 1992–2003. *Mar. Mammal Sci.* **2006**, *20*, 1–27. [CrossRef]
24. Cañadas, A. Towards Conservation of Dolphins in the Alborán Sea. Hacia La Conservación de Los Delfines En El Mar de Alborán. Ph.D. Thesis, Universidad Autónoma de Madrid, Madrid, Spain, 2006.
25. De Stephanis, R.; Cornulier, T.; Verborgh, P.; Sierra, J.S.; Gimeno, N.P.; Guinet, C. Summer spatial distribution of cetaceans in the strait of gibraltar in relation to the oceanographic context. *Mar. Ecol. Prog. Ser.* **2008**, *353*, 275–288. [CrossRef]
26. Verborgh, P.; De Stephanis, R.; Pérez, S.; Jaget, Y.; Barbraud, C.; Guinet, C. Survival rate, abundance, and residency of long-finned pilot whales in the strait of gibraltar. *Mar. Mammal Sci.* **2009**, *25*, 523–536. [CrossRef]
27. Brito, C.; Vieira, N.; Sá, E.; Carvalho, I. Cetaceans' occurrence off the west central portugal coast: A compilation of data from whaling, observations of opportunity and boat-based surveys. *Environ. Res.* **2009**, *2*, 2–5.
28. Forcada, J.; Hammond, P. Geographical variation in abundance of striped and common dolphins of the western mediterranean. *J. Sea Res.* **1998**, *39*, 313–325. [CrossRef]
29. Peddemors, V.M. Delphinids of Southern Africa: A review of their distribution, status and life history. *J. Cetacean Res. Manag.* **1999**, *1*, 157–165.
30. Cañadas, A.; Sagarminaga, R.; García-Tiscar, S. Cetacean distribution related with depth and slope in the mediterranean waters off Southern Spain. *Deep. Res. Part I Oceanogr. Res. Pap.* **2002**, *49*, 2053–2073. [CrossRef]
31. Evans, P.G.H.; Hammond, P.S. Monitoring cetaceans in european waters. *Mamm. Rev.* **2004**, *34*, 131–156. [CrossRef]
32. Evans, P. *Dolphins*; Whittet Books Limited: London, UK, 1994.
33. Gannier, A. Les Cétacés de Méditerranée Nord-Occidentale: Estimation de Leur Abondance et Mise En Relation de La Variation Saisonnière de Leur Distribution Avec l'écologie Du Milieu. Ph.D. Thesis, Ecole Pratique des Hautes Etudes, Montpellier, France, 1995.
34. Santos, M.; German, I.; Correia, D.; Read, F.; Martinez Cedeira, J.; Caldas, M.; López, A.; Velasco, F.; Pierce, J. Long-Term variation in common dolphin diet in relation to prey abundance. *Mar. Ecol. Prog. Ser.* **2013**, *481*, 249–268. [CrossRef]

35. Pusineri, C.; Magnin, V.; Meynier, L.; Spitz, J.; Hassani, S.; Ridoux, V. Food and feeding ecology of the common dolphin (*Delphinus delphis*) in the oceanic northeast atlantic and comparison with its diet in neritic areas. *Mar. Mammal Sci.* **2007**, *23*, 30–47. [CrossRef]
36. Spitz, J.; Mourocq, E.; Léauté, J.-P.; Quéro, J.-C.; Ridoux, V. Prey selection by the common dolphin: Fulfilling high energy requirements with high quality food. *J. Exp. Mar. Biol. Ecol.* **2010**, *390*, 73–77. [CrossRef]
37. Gannier, A. Present distribution of common dolphin *Delphinus delphis* in French mediterranean and adjacent waters as obtained from small boat surveys. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **2018**, 1–8. [CrossRef]
38. Vinding, K.; Bester, M.; Kirkman, S.P.; Chivell, W.; Elwen, S.H. The Use of Data from a platform of opportunity (Whale Watching) to study coastal cetaceans on the southwest coast of South Africa. *Tour. Mar. Environ.* **2015**, *11*, 33–54. [CrossRef]
39. Shane, S.H. Behavior and ecology of the bottlenose dolphin at Sanibel Island, Florida. *Bottlenose Dolphin* **1990**, 245–265.
40. Neumann, D.R.; Orams, M.B. Behaviour and ecology of common dolphins (*Delphinus delphis*) and the impact of tourism in mercury bay, North Island, New Zealand. *Sci. Conserv.* **2005**, 5–40.
41. Wood, S.N. *Generalized Additive Models: An Introduction with R*, 2nd ed.; CRC Press: New York, NY, USA, 2017. [CrossRef]
42. Marra, G.; Wood, S.N. Practical variable selection for generalized additive models. *Comput. Stat. Data Anal.* **2011**, *55*, 2372–2387. [CrossRef]
43. Kämpf, J.; Chapman, P. *Upwelling Systems of the World*; Springer: Cham, Switzerland, 2016. [CrossRef]
44. Stockin, K.A.; Pierce, G.J.; Binedell, V.; Wiseman, N.; Orams, M.B. Factors affecting the occurrence and demographics of common dolphins (*Delphinus* sp.) in the Hauraki Gulf, New Zealand. *Aquat. Mamm.* **2008**, *34*, 200–211. [CrossRef]
45. Würsig, B. Occurrence and group organization of Atlantic bottlenose porpoises (*Tursiops truncatus*) in an argentine bay. *Biol. Bull.* **1978**, *154*, 348–359. [CrossRef]
46. Evans, P.G.H. *The Natural History of Whales and Dolphins*; Christopher Helm Mammal Serie: London, UK, 1987.
47. Bearzi, G.; Notarbartolo-Di-Sciara, G.; Politi, E. Social ecology of bottlenose dolphins in the Kvarneric (Northern Adriatic Sea). *Mar. Mammal Sci.* **1997**, *13*, 650–668. [CrossRef]
48. Baptista, V.; Silva, P.L.; Relvas, P.; Teodósio, M.A.; Leitão, F. Sea surface temperature variability along the portuguese coast since 1950. *Int. J. Climatol.* **2018**, *38*, 1145–1160. [CrossRef]
49. Cañadas, A.; Vázquez, J.A. Common dolphins in the alboran sea: Facing a reduction in their suitable habitat due to an increase in sea surface temperature. *Deep Sea Res. Part II Top. Stud. Oceanogr.* **2017**, *141*, 306–318. [CrossRef]
50. Cañadas, A.; Hammond, P.S. Abundance and habitat preferences of the short-beaked common dolphin *Delphinus delphis* in the southwestern mediterranean: Implications for conservation. *Endanger. Species Res.* **2008**, *4*, 309–331. [CrossRef]
51. Hammond, P.S.; Bearzi, G.; Bjorge, A.; Forney, K.; Karczmarski, L.; Kasuya, T.; Perrin, W.F.; Scott, M.D.; Wang, J.Y.; Wells, R.S.; et al. *Delphinus delphis*. In *The IUCN Red List of Threatened Species*; International Union for Conservation of Nature and Natural Resources: Gland, Switzerland, 2008; p. e.T6336A12649851. [CrossRef]
52. Würsig, B.; Reeves, R.R.; Ortega-Ortiz, J.G. Global climate change and marine mammals. In *Marine Mammals*; Evans, P.G.H., Raga, J.A., Eds.; Springer US: Boston, MA, USA, 2002; pp. 589–608. [CrossRef]